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AFOEHL REPORT 90-125EQ00094GEF

AD-A226 311

Compliance Testing of The Hydrogen Fluoride Ion Cleaning Facility Kelly AFB TX

PAUL T. SCOTT, Capt, USAF

July 1990

Final Report

AF Occupational and Environmental Health Laboratory (AFSC)
Human Systems Division
Brooks Air Force Base, Texas 78235-5501

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Paul T. Scott

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Consultant, Air Quality Meteorologist

EDWIN C. BANNER III, Colonel, USAF, BSC
Chief, Environmental Quality Division

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13. ABSTRACT *(Maximum 200 words)*

Source Emission Testing was conducted on the Kelly AFB Fluoride Ion Cleaning Facility, Building 339 during April 1990. The fluoride emission rate was determined during normal operation. The facility was found to be in compliance with their Texas Air Control Board Construction Permit #S-17940.

14. SUBJECT TERMS
Emission Testing Fluoride Kelly Scott
Air Quality

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STATEMENT "A" per Jean Brown
AF OCcupational and Environment Health
Lab/SVA Brooks AFB, TX 78235-5501
TELECON 9/6/90 VG

Illustrations

I. INTRODUCTION

HQ San Antonio-ALC/EM requested AFOEHL/EQE (Request letter dated 23 October 89 Appendix A) conduct source emission testing for total fluorides on their Hydrogen Fluoride Ion Cleaning Facility. Testing was required for Texas Air Control Board (TACB) permit compliance. AFOEHL personnel conducting the test and Kelly AFB points of contact are listed in Appendix B.

II. DISCUSSION

A. Background

On August 5, 1987 the San Antonio Air Logistic Center received authorization via permit No. S-17940 to construct a Fluoride Ion Cleaning Facility. Source emission testing for fluorides was required within 180 days of initial start up. A pretest meeting with the TACB was scheduled several times and finally occurred on 2 Mar 90 with testing scheduled for 23 April - 3 May. Actual testing occurred on 25 April, 27 April, and 1 May 90.

B. Site Description

The Fluoride Ion Cleaning Facility is located in Building 339 on Kelly AFB. The purpose of this facility is to chemically etch corrosion from small engine and airplane parts. Parts are cleaned in a pressurized and heated retort. The fluoride is via hydrogen fluoride (HF) which flows through the retort at approximately 70 standard cubic feet per hour (SCFH). Hydrogen serves as the carrier gas. The excess HF and metal fluorides flow through a vent fume (sodium hydroxide) scrubber then the exhaust gas exits out the roof. HF flows in three cycles with each cycle lasting about 40 minutes during a 4-hour period. The entire process is about 24 hours.

C. Applicable Standards

Allowable fluoride emission rates for the Fluoride Ion Cleaning Facility are listed in the facilities construction permit, permit no. S-17940 (Appendix C). The Maximum Allowable Emission Rate table gives the allowable fluoride limit as 0.003 lbs/hr.

D. Sampling Methods and Procedures

The test (per TACB directive at 1 March pre-test meeting) consists of three runs, each run is approximately 2.0 hrs cumulative on alternate days beginning 25 April 90. The sampling train consists of a button hook probe connected to four impingers, in sequence via glass and Teflon connections. The four impingers are set up per EPA method 13a for fluorides. The first and second impingers each contain 100 ml of distilled water. The third impinger is dry. The last impinger containing 200 g of indicating silica gel is connected to the meterbox which pulls the sample at a rate of 0.5 CFM. Figure 1 shows a schematic of the sampling train. In addition, a dry gas meter is connected to the exhaust stack of the unit. Figure 2 shows where the stack is connected to the dry gas meter. Volumetric flow is recorded every five minutes.

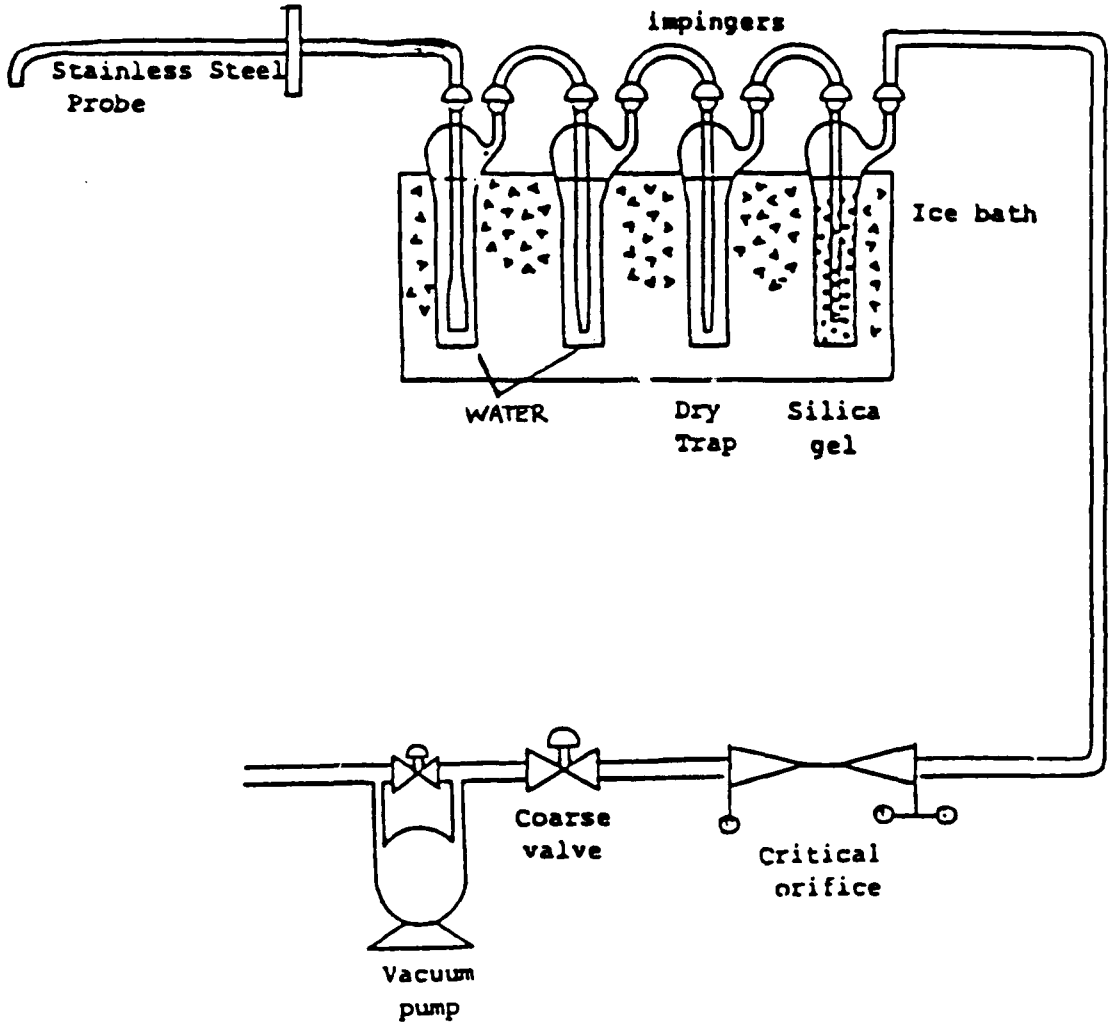

Figure 1: Sampling Train Schematic

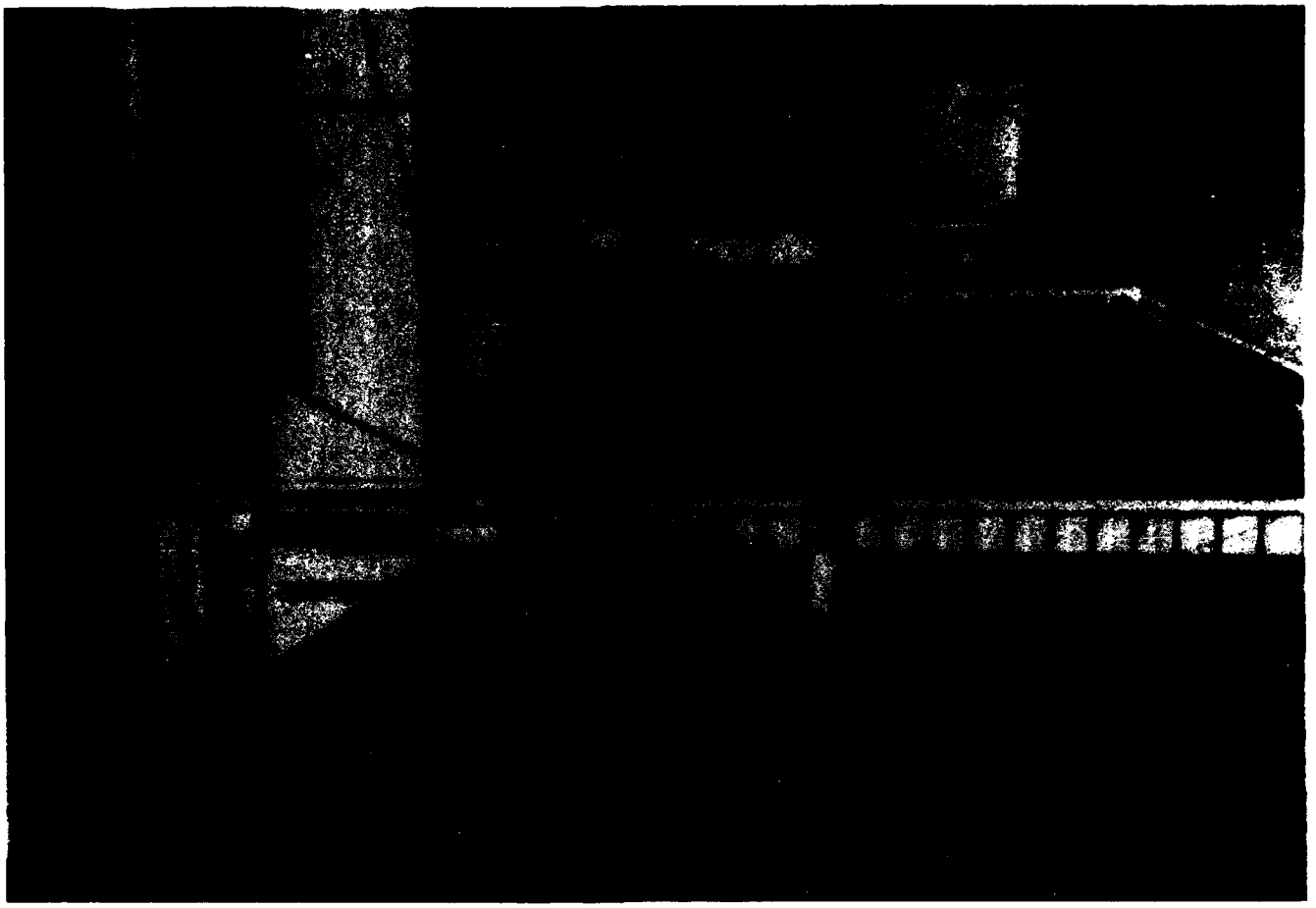

Figure 2: View of Stack

After determining moisture content, the condensate is analyzed for total fluorides using ion chromatography. According to the EPA (per telephone conference 5 Dec 89 with Joe Knoll, ph (919)541-2952), ion chromatography is an acceptable alternative to the colorimetric technique of Method 13A and will eventually be adopted and included as a fluoride test analysis method in 40 CFR 60. Results are compared to the standard as equivalent to HF emissions.

E. Results

Table 1 gives the fluoride emission rates as well as a summary of the test data. The average emission rate for the three runs is an order of magnitude less than the allowable rate; therefore, the facility is in compliance. In addition, the efficiency of the NaOH vent fume scrubber was calulated at 1.0 E-7 less than 100%. All of the test data and laboratory analysis are listed in Appendix D. The emission equations and calculations are listed in Appendix E. Calibration data is listed in Appendix F.

Table 1. Emissions Results

RUN #	Meter Volume (scf)*	Exhaust Flow Rate (scfh)*	% Water	Fluoride Catch (mg)	Fluoride Catch (lbs)	Emission Rate (lbs/hr)
1	65.086	400.2	6.68	18.46	4.066E-5	2.50E-4
2	68.785	401.4	6.09	19.46	4.286E-5	2.46E-4
3	69.607	394.7	6.46	37.95	8.359E-5	4.74E-4
Averages		398.8	6.41			3.23E-4

* scf = standard cubic feet
scfh = standard cubic feet per hour

III. CONCLUSIONS

The Kelly AFB Fluoride Ion Cleaning Facility, Bldg 339, is in compliance with state emission standards for fluorides as listed in their construction permit. In addition, the efficiency of their sodium hydroxide scrubber is near 100% as reported in the facility's permit application. The measured fluorides are a result of the sodium fluoride formed in the scrubbing operation which is carried up the water vapor plume.

IV. RECOMMENDATIONS

Scrubber efficiency cannot be improved; however, a modification in the design of the system could reduce fluoride emissions by another order of magnitude below the measured fluoride emission rates. By rerouting the effluent stack through a condensation trap or other moisture trap, the percent moisture would be significantly reduced. Consequently, the collected fluorides would be similarly reduced. With the trend for stricter toxic emission standards, the recommended change is an inexpensive method to be better prepared (from a regulatory point of view) and better environmentally.

References

1. Code of Federal Regulations, Vol 40, Parts 53-60, The Office of the Federal Register Nati nal Archives and Records Service, General Services Administration, Washington DC, July 1987.

2. Quality Assurance Handbook for Air Pollution Measurement Systems - Volume III, Stationary Source Specific Methods, U.S. Environmental Protection Agency, EPA-600/4-77-027-b, Research Triangle Park, North Carolina, December 1984.

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APPENDIX A
Request Letter

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SAN ANTONIO AIR LOGISTICS CENTER (AFLC)
KELLY AIR FORCE BASE, TEXAS 78241-5000

23 OCT 1989

REPLY TO ATTN OF: EM

SUBJECT: Stack Testing - Flouride Ion Cleaning Unit - Bldg 339

TO: AFOEHL/ECQ

1. Please conduct stack sampling of the Flouride Ion Cleaning Unit located in Bldg 339 on Kelly AFB. The stack sampling is required to satisfy Texas Air Control Board Permit provisions for this unit. It is important that this air sampling be completed by 26 Jan 90. We have discussed this sampling with Capt Scott. If you require further information, please contact Mr C.B. Laughlin or Mr Jerry Bingham at 925-6874/6905.

C. RONALD JONES, Col, USAF, BSC
Director of Environmental Management

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APPENDIX B
PERSONNEL

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Personnel

1. AFOEHL

Capt Paul T. Scott	Chief, Air Quality Function
Capt Ronald Vaughn	Consultant, Air Quality Engineer
Lt Robert O'Brien	Consultant, Air Quality Engineer

AFOEHL/EQE
Brooks AFB TX 78235-5501
AV 240-3305
COM (512)536-3305

2. Kelly AFB

Jerry Bingham	SA-ALC/EM (512) 925-6874
Paul Mehafe	SA-ALC/MAQVE (512) 925-7716

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Appendix C
Construction Permit

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TEXAS AIR CONTROL BOARD

A CONSTRUCTION PERMIT
IS HEREBY ISSUED TO

SAN ANTONIO AIR LOGISTICS CENTER

AUTHORIZING CONSTRUCTION OF

Fluoride Ion Cleaning Facility

TO BE LOCATED AT

San Antonio, Bexar County, Texas
Lat. 29°22'13" Long. 98°33'48"

and which is to be constructed in accordance with and subject to the Texas Clean Air Act, as amended (Article 4477-5, V.A.T.S.), and all Rules, Regulations and Orders of the Texas Air Control Board. Said construction is subject to any additional or amended Rules, Regulations and Orders of the Board adopted pursuant to the Act and to all of the following conditions:

1. This permit may not be transferred, assigned or conveyed by the holder and applies only to the location specified herein.

2. This permit is automatically void upon the occurrence of any of the following:
   a. The issuance or denial of an operating permit.
   b. Failure to begin construction within eighteen months of the date of issuance.
   c. Discontinuance of construction for a period of eighteen consecutive months or more.

3. This permit becomes invalid if construction is not completed within a reasonable time.

4. The facility covered by this permit shall be constructed as specified in the application for permit to construct.

5. The Board shall be notified prior to the start-up of the facility authorized by this permit in such a manner that a representative of the Texas Air Control Board may be present at the time of start-up.

6. The Board shall be notified prior to the start of any required monitoring of the facility authorized by this permit in such a manner that a representative of the Texas Air Control Board may be present during monitoring.

7. This permit is not a guarantee that the facility will receive an operating permit at the end of the construction period, nor does it absolve the holder from the responsibility for the consequences of noncompliance with all Rules, Regulations and Orders of the Texas Air Control Board or with the intent of the Texas Clean Air Act.

8. Emissions from this facility must not cause or contribute to a condition of 'air pollution' as defined in Section 1.03 of the Texas Clean Air Act or violate Section 4.01 of the Texas Clean Air Act, Article 4477-5, V.A.T.S. If the Executive Director of the Texas Air Control Board determines that such a condition or violation occurs, the holder shall implement additional abatement measures as necessary to control or prevent the condition or violation.

9. Special Provisions: See attachments labeled "General Provisions S-17940," 1-5, and "Special Provisions S-17940," 1-2.

Acceptance of the permit constitutes an acknowledgement and agreement that the holder will comply with all Rules, Regulations and Orders of the Board issued in conformity with the Act and the conditions precedent to the granting of this permit. Failure to comply with all special provisions of this permit will subject the holder to the enforcement provisions of the Texas Clean Air Act, Article 4477-5, V.A.T.S.

PERMIT NO. S-17940 DATE August 5, 1987

Eli Bell
EXECUTIVE DIRECTOR
TEXAS AIR CONTROL BOARD

Steve Spaw
Deputy Executive Director

GENERAL PROVISIONS

S-17940

1. Equivalency of Methods - It shall be the responsibility of the holder of this permit to demonstrate or otherwise justify the equivalency of emission control methods, sampling or other emission testing methods and monitoring methods proposed as alternatives to methods indicated in the provisions of this permit. Alternative methods shall be applied for in writing and shall be reviewed and approved by the Executive Director prior to their use in fulfilling any requirements of this permit.

2. Sampling Requirements - If sampling of stacks or process vents is required, the holder of this permit must contact the Quality Assurance Division of the Texas Air Control Board prior to sampling to obtain the proper data forms and procedures. The holder of this permit is also responsible for providing sampling facilities and conducting the sampling operations at his own expense.

3. Appeal - This permit may be appealed pursuant to Rule 103.81 of the Procedural Rules of the Texas Air Control Board and Section 6.01 of the Texas Clean Air Act. Failure to take such appeal constitutes acceptance by the applicant of all terms of the permit.

4. Construction Progress - Start of construction, construction interruptions exceeding 45 days and completion of construction shall be reported to the appropriate regional office of the Texas Air Control Board not later than ten (10) working days after occurrence of the event. This provision shall not apply to operating permits.

5. Record Keeping - Information and data concerning production, operating hours, sampling and monitoring data, if applicable, fuel type and fuel sulfur content, if applicable, shall be maintained in a file at the plant site and made available at the request of personnel from the Texas Air Control Board or any local air pollution control agency having jurisdiction. The file shall be retained for at least two years following the date that the information or data is obtained.

SPECIAL PROVISIONS

S-17940

1. This permit covers only those sources of emissions listed in the attached table entitled "Emission Sources - Maximum Allowable Emission Rates" and those sources are limited to the emission limits and other conditions specified in that attached table.

2. The holder of this permit shall perform stack sampling and other testing as required to establish the actual pattern and quantities of air contaminants being emitted into the atmosphere from the scrubber stack of the fluoride ion cleaning facility. The holder of this permit is responsible for providing sampling and testing facilities and conducting the sampling and testing operation at his expense.

   A. The Texas Air Control Board (TACB) regional office in the region where the source is located shall be contacted as soon as testing is scheduled but not less than 45 days prior to sampling to schedule a pretest meeting.

      The notice shall include:

      1. Date for pretest meeting.
      2. Date sampling will occur.
      3. Name of firm conducting sampling.
      4. Type of sampling equipment to be used.
      5. Method or procedure to be used in sampling.

      The purpose of the pretest meeting is to review the necessary sampling and testing procedures, to provide the proper data forms for recording pertinent data and to review the format procedures for submitting the test reports.

      A written proposed description of any deviation from sampling procedures specified in permit provision or TACB or EPA sampling procedures shall be made available to the TACB at or prior to the pretest meeting. The regional director or the director of the Quality Assurance Division shall approve or disapprove of any deviation from specified sampling procedures. Requests to waive testing for any pollutant specified in B of this provision shall be submitted to the TACB Permits Division. Test waivers and alternate/equivalent procedure proposals for NSPS testing which must have EPA approval shall be submitted to the TACB Quality Assurance Division in Austin.

   B. Air contaminants emitted from the scrubber stack to be tested for include (but are not limited to) hydrogen fluoride.

C. Sampling shall occur within 60 days after the facilities achieve maximum production, but not later than 180 days after initial start-up of the facilities and at such other times as may be required by the Executive Director of the TACB. Requests for additional time to perform sampling shall be submitted to the regional office. Additional time to comply with the requirements of 40 CFR 60 and 40 CFR 61 cannot be granted.

D. Three copies of the final sampling report shall be forwarded to the TACB within 30 days after sampling is completed. Sampling reports shall comply with the provisions of Chapter 14 of the TACB Sampling Procedures Manual. The reports shall be distributed as follows:

One copy to the appropriate Texas Air Control Board regional office.
One copy to each appropriate local air pollution control program.
One copy to the Quality Assurance Division, TACB, Austin Office.

EMISSION SOURCES - MAXIMUM ALLOWABLE EMISSION RATES

S-17940

This table lists all sources of air contaminants on applicant's property emitted by the facility covered by this **permit.** The emission rates shown are those derived from information submitted as part of the application for permit **and are** the maximum rates allowed for these facilities. Any proposed increase in emission rates may require an **application** for a modification of the facilities covered by this permit.

EMISSION POINT ID (1)'	SOURCE NAME (2)	AIR CONTAMINANT DATA — EMISSION RATES*											
		AR (3)		HF (4)		H_2 (5)							
		#/HR	T/Y	#/HR	T/Y	#/HR	T/Y	#/HR	T/Y	#/HR	T/Y	#/HR	T/Y
339-001	Fluoride Ion Cleaning	3.1	1.4	0.003	0.001	0.34	0.08						

(1) Emission point identification - either specific equipment designation or emission point number from plot plan.
(2) Specific point source name. For fugitive sources use area name or fugitive source name.
(3) Argon.
(4) Hydrogen Fluoride.

[illegible] the following operating schedule: [illegible]

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APPENDIX D
Test Data

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HF Ion Cleaning Facility

Emission Test Data

RUN/DATE	START VOLUME	STOP VOLUME	START TIME	STOP TIME	Elapsed Time	DV (cu ft)	DV/DT (cfm)
1A/25 Apr	310.655	334.830	0924	1006	42	24.175	.576
1B/25 Apr	334.830	357.622	1042	1128	50	22.792	.496
1C/25 Apr	357.622	379.087	1202	1246	44	21.465	.488
Totals					136	68.432	.503
2A/27 Apr	379.085	405.460	0937	1027	50	26.375	.528
2B/27 Apr	405.460	428.219	1058	1145	47	22.759	.484
2C/27 Apr	428.219	449.965	1217	1302	45	21.746	.483
Totals					142	70.880	.493
3A/01 May	449.960	471.946	0929	1014	45	21.986	.489
3B/01 May	471.496	499.184	1044	1129	45	27.238	.495
3C/01 May	499.184	521.780	1200	1246	46	22.596	.491
Totals					141	71.820	.509

Collected Volumes of Condensate

Run	IMPINGER 1	IMPINGER 2	IMPINGER 3	IMPINGER 4	Totals
1	173.0	110.0	1.0	215.0	
	-100.0	-100.0	-0.0	-200.0	
	73.0	10.0	1.0	15.0	99.0
2	165.5	110.5	2.0	216.2	
	-100.0	-100.0	-0.0	-200.0	
	65.5	10.5	2.0	16.2	94.7
3	175.0	111.0	1.5	214.7	
	-100.0	-100.0	0.0	-200.0	
	75.0	11.0	1.5	14.7	102.1

Temperature Data (deg F)

Run		Tin/Tout	Tstack	Timpingers
1	start	80/82	83	68/67/68
	end	91/97	85	64/65/60
Avg		94	84	
2		76/78	82	68/59/65
		88/92	82	52/62/67
Avg		83.5	82	
3		79/80	83	61/57/67
		87/93	84	65/67/68
Avg		84.75	83.5	

Exhaust Data
25 April 90 - Run 1A

Elapsed Time (min:sec)	Meter Reading (cu ft)	Measured Volume (cu ft)	Flow Rate (CFH)
0:00	500.3	----	-----
5:00	533.4	33.1	397.2
10:00	569.1	35.7	428.4
15:00	605.1	36.0	432.0
20:00	640.5	35.4	424.8
25:00	676.4	35.9	430.8
30:00	712.2	35.8	429.6
35:00	748.1	35.9	430.8
39:33	781.0	32.9	433.8
		Average =	425.9

25 April 90 - Run 1B

Elapsed Time (min:sec)	Meter Reading (cu ft)	Measured Volume (cu ft)	Flow Rate (CFH)
0:00	802.2	----	-----
5:00	837.9	35.7	428.4
10:00	873.9	36.0	432.0
15:00	910.0	36.1	433.2
20:00	946.4	36.4	436.8
25:00	982.6	36.2	434.4
30:00	018.6	36.0	432.0
35:00	054.6	36.0	432.0
39:44	088.8	34.2	433.5
		Average =	432.8

25 April 90 - Run 1C

Elapsed Time (min:sec)	Meter Reading (cu ft)	Measured Volume (cu ft)	Flow Rate (CFH)
0:00	093.4	----	-----
5:00	129.6	36.2	434.4
10:00	165.3	35.7	428.4
15:00	201.3	36.0	432.0
20:00	237.2	35.9	430.8
25:00	272.8	35.6	427.2
30:00	308.3	35.5	426.0
35:00	343.6	35.3	423.6
40:00	378.6	35.0	420.0
		Average =	427.8

Run 1 Avg Flow Rate (CFH) = 428.8
Run 1 Avg Exit Velocity (ft/s) = 21.8

Exhaust Data
27 April 90 - Run 2A

Elapsed Time (min:sec)	Meter Reading (cu ft)	Measured Volume (cu ft)	Flow Rate (CFH)
0:00	390.4	----	-----
5:00	425.0	34.6	415.2
10:00	460.2	35.2	422.4
15:00	495.2	35.0	420.0
20:00	530.1	34.9	418.8
25:00	565.0	34.9	418.8
30:00	599.1	34.1	409.2
35:00	634.8	35.7	428.4
40:00	669.7	34.9	418.8
45:00	704.8	35.1	421.2
50:00	739.9	35.1	421.2
50:41	744.6	4.7	*
		Average =	419.4

27 April 90 - Run 2B

Elapsed Time (min:sec)	Meter Reading (cu ft)	Measured Volume (cu ft)	Flow Rate (CFH)
0:00	748.6	----	-----
5:00	783.5	34.9	418.8
10:00	818.7	35.2	421.2
15:00	854.3	35.6	427.2
20:00	889.9	35.6	427.2
25:00	925.7	35.8	429.6
30:00	961.3	35.6	427.2
35:00	997.0	35.7	428.4
40:00	033.2	36.2	434.4
42:47	053.3	20.1	433.3
		Average =	427.5

27 April 90 - Run 2C

Elapsed Time (min:sec)	Meter Reading (cu ft)	Measured Volume (cu ft)	Flow Rate (CFH)
0:00	062.4	----	-----
5:00	097.8	35.4	424.8
10:00	133.8	36.0	432.0
15:00	170.1	36.3	435.6
20:00	206.5	36.4	436.8
25:00	242.9	36.4	436.8
30:00	279.4	36.5	438.0
35:00	316.0	36.6	439.2
40:00	352.5	36.5	438.0
40:59	359.7	7.2	*
		Average =	435.2

Run 2 Avg Flow Rate (CFH) = 427.4
Run 2 Avg Exit Velocity (ft/s) = 21.8

* Flow rate not calculated due to short time duration.

Exhaust Data
1 May 90 - Run 3A

Elapsed Time (min:sec)	Meter Reading (cu ft)	Measured Volume (cu ft)	Flow Rate (CFH)
0:00	376.5	----	-----
5:00	412.1	35.6	427.2
10:00	446.4	34.3	411.6
15:00	480.2	33.8	405.6
20:00	514.6	34.4	412.8
25:00	549.1	34.5	414.0
30:00	583.6	34.5	414.0
35:00	618.1	34.5	414.0
40:00	652.9	34.8	417.6
40:56	659.3	6.4	*
		Average =	414.6

1 May 90 - Run 3B

Elapsed Time (min:sec)	Meter Reading (cu ft)	Measured Volume (cu ft)	Flow Rate (CFH)
3:00	663.8	----	-----
8:00	698.5	34.7	416.4
13:00	733.5	35.0	420.0
18:00	768.5	35.0	420.0
23:00	803.6	35.1	421.2
28:00	838.8	35.2	422.4
33:00	874.1	35.3	423.6
38:00	909.4	35.3	423.6
40:19	925.7	16.3	*
		Average =	421.0

1 May 90 - Run 3C

Elapsed Time (min:sec)	Meter Reading (cu ft)	Measured Volume (cu ft)	Flow Rate (CFH)
3:00	926.9	----	-----
8:00	961.9	35.0	420.0
13:00	997.6	35.7	428.4
18:00	033.5	35.9	430.8
23:00	069.6	36.1	433.2
28:00	105.7	36.1	433.2
33:00	141.6	35.9	430.8
38:00	177.7	36.1	433.2
41:52	205.7	28.0	434.5
		Average =	430.5

Run 3 Avg Flow Rate (CFH) = 422.0
Run 3 Avg Exit Velocity (ft/s) = 21.5

* Flow rate not calculated due to short time duration.

ENVIRONMENTAL SAMPLING DATA

OEHL USE ONLY

(Use this space for mechanical imprint)

SAMPLING SITE IDENTIFIER *(AFR 19-7)*

BASE WHERE SAMPLE COLLECTED: Kelly AFB

SAMPLING SITE DESCRIPTION: Bldg 339

DATE COLLECTION BEGAN (YYMMDD): 9 1 0 0 4 2 5

TIME COLLECTION BEGAN *(24 hour clock)*: N/A

COLLECTION METHOD: ☒ GRAB ☐ COMPOSITE ______ HOURS

MAIL REPORTS TO *(circle if changed)*

- ORIGINAL: AFOEHL/EQE Bldg 175W Attn Capt Scott
- COPY 1:
- COPY 2:

SAMPLE COLLECTED BY *(Name, Grade, AFSC)*: Paul Scott Capt

SIGNATURE: Paul T Scott

AUTOVON: 11-2991

REASON FOR SUBMISSION: E R

A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC C-COMPLAINT N-NPDES F-FOLLOWUP/CLEANUP O-OTHER *(specify)* ______

BASE SAMPLE NUMBER: G N 9 0 0 0 0 1

ANALYSES REQUESTED *(Check appropriate blocks)*

	GROUP A										
				Hardness	00900		Silica	00955		2, 4, 5-T	39740
	Ammonia	00610		Iron	01045		Specific Conductance	00095		2, 4, 5-TP-Silvex	39760
	Chemical Oxygen Demand	00340		Lead	01051		Sulfate	00945			
	Kjeldahl Nitrogen	00625		Magnesium	00927		Surfactans-MBAS	38260			
	Nitrate	00620		Manganese	01055		Turbidity	00076			
	Nitrite	00615		Mercury	71900						
	Oil & Grease	00560		Nickel	01067						
	Organic Carbon	00680		Potassium	00937						
	Orthophosphate	00671		Selenium	01147		GROUP H				
	Phosphorus, Total	00665		Silver	01077		Aldrin	39330			
				Sodium	00929		BHC Isomers	39340			
	GROUP D			Thallium	01059		a-BHC	39337			
	Cyanide, Total	00720		Zinc	01092		b-BHC	39338			
	Cyanide, Free	00722					d-BHC	34259			
							Chlordane	39350		GROUP J	
	GROUP E			GROUP G			DDT Isomers	39370		Sulfides	00745
	Phenols	32730		Acidity, Total	70508		p, p-DDD	39310			
				Alkalinity, Total	00410		p, p-DDE	39320			
	GROUP F			Alkalinity, Bicarbonate	00425		p, p-DDT	39300			
	Antimony	01097		Bromide	71870		Dieldrin	39380			
	Arsenic	01002		Carbon Dioxide	00405		Dursban	77969			
	Barium	01007		Chloride	00940		Endrin	39390			
	Beryllium	01012		Color	00080		Heptachlor	39410			
	Boron	01022	X	Fluoride	00951		Heptachlor Epoxide	39420			
	Cadmium	01027		Residue, Total	00500		Lindane	39782			
	Calcium	00916		Residue, Filterable *(TDS)*	70300		Methoxychlor	39480			
	Chromium, Total	01034		Residue, Nonfilterable	00530		Pramitol *(Pramaton)*	XY4200000			
	Chromium VI	01032		Residue, Settleable	50085		Toxaphene	39400			
	Copper	01042		Residue, Volatile	00505		2, 4-D	39730			

ON SITE ANALYSES

PARAMETER		VALUE
Flow	50050	mgd
Chlorine, Total	50060	mg/l
Dissolved Oxygen	00300	mg/l
pH	00400	units
Temperature	00010	°C
Odor	00086	
Iodide	71865	
Sulfite	00740	

REMARKS

Run #1 11. 284.1) nil 65 mg/l 18.-mg = [illegible]

AF FORM 2752A AF FORMS 2752A AND 2752B FEB 69 REPLACE AF FORM 2752 JAN 61 WHICH WILL BE USED.

ENVIRONMENTAL SAMPLING DATA

OEHL USE ONLY

(Use this space for mechanical imprint)

SAMPLING SITE IDENTIFIER (AFR 19-7)

BASE WHERE SAMPLE COLLECTED: Kelly AFB

SAMPLING SITE DESCRIPTION

DATE COLLECTION BEGAN (YYMMDD): 9 10 10 9 12 17

TIME COLLECTION BEGAN (24 hour clock): N/A

COLLECTION METHOD: ☑ GRAB ☐ COMPOSITE _____ HOURS

MAIL REPORTS TO (circle if changed)

ORIGINAL: AFOEHL/EQE Bldg 175W Attn Capt Scott

COPY 1:

COPY 2:

SAMPLE COLLECTED BY (Name, Grade, AFSC): Paul Scott Capt

SIGNATURE: Paul T Scott

AUTOVON: Local 4-7891

REASON FOR SUBMISSION: E R

A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC C-COMPLAINT N-NPDES F-FOLLOWUP/CLEANUP O-OTHER (specify) _____

BASE SAMPLE NUMBER: GN 90 0002

ANALYSES REQUESTED (Check appropriate blocks)

	GROUP A			Hardness	00900		Silica	00955		2, 4, 5-T	39740
	Ammonia	00610		Iron	01045		Specific Conductance	00095		2, 4, 5-TP-Silvex	39760
	Chemical Oxygen Demand	00340		Lead	01051		Sulfate	00945			
	Kjeldahl Nitrogen	00625		Magnesium	00927		Surfactans-MBAS	38260			
	Nitrate	00620		Manganese	01055		Turbidity	00076			
	Nitrite	00615		Mercury	71900						
	Oil & Grease	00560		Nickel	01067						
	Organic Carbon	00680		Potassium	00937						
	Orthophosphate	00671		Selenium	01147		GROUP H				
	Phosphorus, Total	00665		Silver	01077		Aldrin	39330			
				Sodium	00929		BHC Isomers	39340			
	GROUP D			Thallium	01059		a-BHC	39337			
	Cyanide, Total	00720		Zinc	01092		b-BHC	39338			
	Cyanide, Free	00722					d-BHC	34259			
							Chlordane	39350		GROUP J	
	GROUP E			GROUP G			DDT Isomers	39370		Sulfides	00745
	Phenols	32730		Acidity, Total	70508		p, p-DDD	39310			
				Alkalinity, Total	00410		p, p-DDE	39320			
	GROUP F			Alkalinity, Bicarbonate	00425		p, p-DDT	39300			
	Antimony	01097		Bromide	71870		Dieldrin	39380		ON SITE ANALYSES	
	Arsenic	01002		Carbon Dioxide	00405		Dursban	77969		PARAMETER	VALUE
	Barium	01007		Chloride	00940		Endrin	39390		Flow 50050	mgd
	Beryllium	01012		Color	00080		Heptachlor	39410		Chlorine, Total 50060	mg/l
	Boron	01022	X	Fluoride	00951		Heptachlor Epoxide	39420		Dissolved Oxygen 00300	mg/l
	Cadmium	01027		Residue, Total	00500		Lindane	39782		pH 00400	units
	Calcium	00916		Residue, Filterable (TDS)	70300		Methoxychlor	39480		Temperature 00010	°C
	Chromium, Total	01034		Residue, Nonfilterable	00530		Pramitol (Pramaton)	XY4200000		Odor 00086	
	Chromium VI	01032		Residue, Settleable	50085		Toxaphene	39400		Iodide 71865	
	Copper	01042		Residue, Volatile	00505		2, 4-D	39730		Sulfite 00740	

REMARKS

Run #2 Vol 278 ml 70 mg/l 19.46 mg

ENVIRONMENTAL SAMPLING DATA

OEHL USE ONLY

(Use this space for mechanical imprint)

SAMPLING SITE IDENTIFIER (AFR 19-7)

BASE WHERE SAMPLE COLLECTED: Kelly AFB

SAMPLING SITE DESCRIPTION: Bldg 339

DATE COLLECTION BEGAN (YYMMDD): 910510 11

TIME COLLECTION BEGAN (24 hour clock): N/A

COLLECTION METHOD: ☑ GRAB ☐ COMPOSITE _____ HOURS

MAIL REPORTS TO (circle if changed)

ORIGINAL: AFOEHL/EQE Bldg 175W Attn Capt Scott

COPY 1:

COPY 2:

SAMPLE COLLECTED BY (Name, Grade, AFSC): Paul Scott Capt

SIGNATURE: Paul T Scott

AUTOVON/Local: 4-7891

REASON FOR SUBMISSION: R

A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC C-COMPLAINT N-NPDES F-FOLLOWUP/CLEANUP O-OTHER (specify) _____

BASE SAMPLE NUMBER: KN 40 0003

ANALYSES REQUESTED (Check appropriate blocks)

	GROUP A		Hardness	00900		Silica	00955		2, 4, 5-T	39740
	Ammonia	00610	Iron	01045		Specific Conductance	00095		2, 4, 5-TP-Silvex	39760
	Chemical Oxygen Demand	00340	Lead	01051		Sulfate	00945			
	Kjeldahl Nitrogen	00625	Magnesium	00927		Surfactans-MBAS	38260			
	Nitrate	00620	Manganese	01055		Turbidity	00076			
	Nitrite	00615	Mercury	71900						
	Oil & Grease	00560	Nickel	01067						
	Organic Carbon	00680	Potassium	00937						
	Orthophosphate	00671	Selenium	01147		GROUP H				
	Phosphorus, Total	00665	Silver	01077		Aldrin	39330			
			Sodium	00929		BHC Isomers	39340			
	GROUP D		Thallium	01059		a-BHC	39337			
	Cyanide, Total	00720	Zinc	01092		b-BHC	39338			
	Cyanide, Free	00722				d-BHC	34259			
						Chlordane	39350		GROUP J	
	GROUP E		GROUP G			DDT Isomers	39370		Sulfides	00745
	Phenols	32730	Acidity, Total	70508		p, p-DDD	39310			
			Alkalinity, Total	00410		p, p-DDE	39320			
	GROUP F		Alkalinity, Bicarbonate	00425		p, p-DDT	39300			
	Antimony	01097	Bromide	71870		Dieldrin	39380		ON SITE ANALYSES	
	Arsenic	01002	Carbon Dioxide	00405		Dursban	77969		PARAMETER	VALUE
	Barium	01007	Caloride	00940		Endrin	39390		Flow 50050	mgd
	Beryllium	01012	Color	00080		Heptachlor	39410		Chlorine, Total 50060	mg/l
	Boron	01022	Fluoride	00951		Heptachlor Epoxide	39420		Dissolved Oxygen 00300	mg/l
	Cadmium	01027	Residue, Total	00500		Lindane	39782		pH 00400	units
	Calcium	00916	Residue, Filterable (TDS)	70300		Methoxychlor	39480		Temperature 00010	°C
	Chromium, Total	01034	Residue, Nonfilterable	00530		Pramitol (Pramaton)	XY4200000		Odor 00086	
	Chromium VI	01032	Residue, Settleable	50085		Toxaphene	39400		Iodide 71865	
	Copper	01042	Residue, Volatile	00505		2, 4-D	39730		Sulfite 00740	

REMARKS

R. # > Vol 287, 5-1 132 mg/l 37.95 mg

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AF FORM 2752A FEB 85 AF FORMS 2752A AND 2752B, FEB 85, REPLACE AF FORM 2752, JAN 81, WHICH WILL BE USED.

ENVIRONMENTAL SAMPLING DATA

OEHL USE ONLY

(Use this space for mechanical imprint)

SAMPLING SITE IDENTIFIER (AFR 19-7)

BASE WHERE SAMPLE COLLECTED: Kelly AFB

SAMPLING SITE DESCRIPTION: Bldg 339

DATE COLLECTION BEGAN (YYMMDD): 910105 1011

TIME COLLECTION BEGAN (24 hour clock): N/A

COLLECTION METHOD: ☑ GRAB ☐ COMPOSITE _____ HOURS

MAIL REPORTS TO (circle if changed)

ORIGINAL: AFOEHL/EQE Bldg 175W Attn Capt Scott

COPY 1:

COPY 2:

SAMPLE COLLECTED BY (Name, Grade, AFSC): Paul Scott Capt

SIGNATURE: Paul Scott

AUTOVON: Local 4-2891

REASON FOR SUBMISSION: E

A-ACCIDENT/INCIDENT R-ROUTINE/PERIODIC C-COMPLAINT N-NPDES F-FOLLOWUP/CLEANUP O-OTHER (specify) _____

BASE SAMPLE NUMBER: BK 90 0004

ANALYSES REQUESTED (Check appropriate blocks)

	GROUP A		Hardness	00900		Silica	00955		2, 4, 5-T	39740
	Ammonia	00610	Iron	01045		Specific Conductance	00095		2, 4, 5-TP-Silvex	39760
	Chemical Oxygen Demand	00340	Lead	01051		Sulfate	00945			
	Kjeldahl Nitrogen	00625	Magnesium	00927		Surfactans-MBAS	38260			
	Nitrate	00620	Manganese	01055		Turbidity	00076			
	Nitrite	00615	Mercury	71900						
	Oil & Grease	00560	Nickel	01067						
	Organic Carbon	00680	Potassium	00937						
	Orthophosphate	00671	Selenium	01147		GROUP H				
	Phosphorus, Total	00665	Silver	01077		Aldrin	39330			
			Sodium	00929		BHC Isomers	39340			
	GROUP D		Thallium	01059		a-BHC	39337			
	Cyanide, Total	00720	Zinc	01092		b-BHC	39338			
	Cyanide, Free	00722				d-BHC	34259			
						Chlordane	39350		GROUP J	
	GROUP E		GROUP G			DDT Isomers	39370		Sulfides	00745
	Phenols	32730	Acidity, Total	70508		p, p-DDD	39310			
			Alkalinity, Total	00410		p, p-DDE	39320			
	GROUP F		Alkalinity, Bicarbonate	00425		p, p-DDT	39300			
	Antimony	01097	Bromide	71870		Dieldrin	39380		ON SITE ANALYSES	
	Arsenic	01002	Carbon Dioxide	00405		Dursban	77969		PARAMETER	VALUE
	Barium	01007	Chloride	00940		Endrin	39390		Flow 50050	mgd
	Beryllium	01012	Color	00080		Heptachlor	39410		Chlorine, Total 50060	mg/l
	Boron	01022	X Fluoride	00951		Heptachlor Epoxide	39420		Dissolved Oxygen 00300	mg/l
	Cadmium	01027	Residue, Total	00500		Lindane	39782		pH 00400	units
	Calcium	00916	Residue, Filterable (TDS)	70300		Methoxychlor	39480		Temperature 00010	°C
	Chromium, Total	01034	Residue, Nonfilterable	00530		Pramitol (Pramaton)	XY4200000		Odor 00086	
	Chromium VI	01032	Residue, Settleable	50085		Toxaphene	39400		Iodide 71865	
	Copper	01042	Residue, Volatile	00505		2, 4-D	39730		Sulfite 00740	

REMARKS

BK Volume 200 ml 2.1 mg/l

AF FORM 2752A AF FORMS 2752A AND 2752B, FEB 85, REPLACE AF FORM 2752, JAN 81, WHICH WILL BE USED.

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Appendix E
Emission Equations and Calculation

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1. (Eq 4.1 from 40CFR60 App A)

$$V_{w(std)} = (0.04707\ ft^3/ml)(V_w)$$

2. (Eq 4.3 from 40CFR60 App A)

$$V_{m(std)} = (17.64\ ^oR/in\ Hg)(Y)(V_m P_m/T_m)$$

3. (Eq 4.4 from 40CFR60 App A)

$$B_w = V_{w(std)}/V_{w(std)} + V_{m(std)}$$

4. (Eq 4.4 rearranged to remove water from stack exhaust)

$$FR_{(cor)} = FR - B_w FR$$

5. Converting HF flow rate to lbs of influent fluoride

$$I_t = (I_r)(t)(k_1)(P/RT)(MW_{fl})$$

6. Fluoride Emission Rate(ER_{fl})

$$ER_{fl} = (E_t/V_{m(std)})(FR_{(cor)})$$

7. Scrubber Efficiency(EFF)

$$EFF = (I_t - E_t)/I_t \times 100\%$$

where:

Vw = total volume of water collected (ml)

$V_{w(std)}$ = V_w corrected to standard conditions (cu ft)

Vm = meter volume (CFH(cu ft/hr))

$V_{m(std)}$ = V_m corrected to standard conditions

Y = Meter box correlation factor

P = standard pressure (29.92 in Hg)

T = standard temperature (528 ^{o}R)

R = Universal gas constant
(21.85 (in Hg)(cuft)(lbs-mole)(^{o}R)

Pm = Station Pressure at meter box (in Hg)

Tm = Meter temperature (^{o}R)

B_w = fractional volume of collected water

RF = exhaust flow rate (CFH)

RF(cor) = RF corrected to dry conditions (CFH)

ER = fluoride emission rate (lbs/hr)

E_t = fluoride catch (lbs)

t = cumulative time for a particular run

I_t = influent fluoride mass (lbs)

I_r = influent flow rate of HF (70 SCFH)

MW_{fl} = Molecular weight of fluoride (g/mole)

k_1 = 28.316 l/ft

Results are summarized in Table E1

Table E1

Summary of calculation results

Date	Run	Vw	Vm	Pm	Tm	Vw(std)	Vm(std)	%H2O	FR	FR(cor)	Et	ER
25 Apr 90	1	99.0	68.432	29.90	554.0	4.66	65.086	6.68	428.8	400.2	4.066E-5	2.50E-4
27 Apr 90	2	94.7	70.880	29.93	543.5	4.46	68.875	6.09	427.4	401.4	4.286E-5	2.46E-4
1 May 90	3	102.1	71.821	29.96	544.8	4.81	69.607	6.46	422.0	394.7	8.359E-5	4.74E-4

avg Fl emission rate = 3.23E-4

EFF has been calculated for all runs as 99.999999 %

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Appendix F
Calibration Data

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POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number one Date 10 Jul 90 Meter box number Nutech 2 Plant Post Kelly AFB HF

Barometric pressure, P_b = 29.94 in. Hg Dry gas meter, number _____ Pretest Y 0.999

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average[a] (t_d), °F	Time (θ), min	Vacuum setting, in. Hg	Y_i	$Y_i \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
0.5	10	10.524	76 78 537	81 87 544	77 81 539	541.5	26.765	5	0.9570	$\frac{10(29.94)(541.5)}{(10.524)(29.94+0.5/13.6)53}$
0.5	10	10.616	78 79 538.5	87 90 548.5	81 84 542.5	545.5	26.759	5	0.9530	$\frac{10(29.94)(545.5)}{10.616(29.94+0.5/13.6)53}$
0.5	10	10.655	78 79 539	90 92 551	84 86 545	548 0	26.731	5	0.9530	$\frac{10(29.94)(548.0)}{10.655(29.94+0.5/13.6)53}$
									Y = 0.9543	

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d

where

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in. H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ±0.05Y.

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

$Y \pm 0.05\,Y$

1.049 ← y → 0.949

METER BOX CALIBRATION DATA AND CALCULATION FORM

(English units)

Date 28 Sept 89 Meter box number Nutech 2

Barometric pressure, P_b = 29.82 in. Hg Calibrated by Scott & Vaughn

	Orifice manometer setting (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °R	Temperature: Dry gas meter Inlet (t_{d_i}), °R	Temperature: Dry gas meter Outlet (t_{d_o}), °R	Temperature: Dry gas meter Avg[a] (t_d), °R	Time (Θ), min	Y_i	$\Delta H@_i$ in. H_2O
JAC 4	0.5	5	5.060	78 78 538	79 84 541.5	77 79 538	539.8	12.9	0.990	1.897
4	1.0	5	5.060	79 79 539	87 91 549	80 81 540.5	544.8	9.0	0.996	1.837 ~~1.840~~
4	1.5	10	10.150	80 79 539.5	96 98 557	86 87 546.5	551.8	15.2	1.004	1.943
4	2.0	10	10.195	79 ~~80~~ 539	98 100 559	87 89 548	553.5	13.2	1.002	1.944
4	3.0	10	10.155	79 80 539.5	101 ~~562.5~~ 104 ~~566~~	90 91 550.5	556.5	10.7	1.008	1.910
4	4.0	10	10.025 ~~10.139~~	80 77 538.5	80 ~~89~~ 549.5	74 77 535.5	540	10.0	0.991	2.283
								Avg	0.999	1.969

ΔH, in. H_2O	$\frac{\Delta H}{13.6}$	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_w + 460)}$	$\Delta H@_i = \frac{0.0317\ \Delta H}{P_b (t_d + 460)} \left[\frac{(t_w + 460)\ \Theta}{V_w}\right]^2$
0.5	0.0368	$y_1 = \frac{(5)(29.83)(539.8)}{(5.06)(29.82 + 0.5/13.6)(538)}$	$H@_1 = \frac{(0.0317)(.5)}{(29.82)(539.8)} \left[\frac{(538)(12.9)}{5}\right]^2$
1.0	0.0737	$y_2 = \frac{(5)(29.82)(544.8)}{(5.06)(29.82 + 1/13.6)(539)}$	$H@_2 = \frac{(.0317)(1)}{(29.82)(544.8)} \left[\frac{(539.0)(9.0)}{5}\right]^2$
1.5	0.110	$y_3 = \frac{(10)(29.82)(551.8)}{(10.15)(29.82 + 1.5/13.6)(539.5)}$	$H@_3 = \frac{(.0317)(1.5)}{(29.82)(551.8)} \left[\frac{(539.5)(15.2)}{10}\right]^2$
2.0	0.147	$y_4 = \frac{(10)(29.82)(553.5)}{(10.195)(29.82 + 2.0/13.6)(539)}$	$H@_4 = \frac{(.0317)(2.0)}{(29.82)(553.5)} \left[\frac{(539)(13.2)}{10}\right]^2$
3.0	0.221	$y_5 = \frac{(10)(29.82)(556.5)}{(10.155)(29.82 + 3/13.6)(539.5)}$	$H@_5 = \frac{(.0317)(3.0)}{(29.82)(556.5)} \left[\frac{(539.5)(10.7)}{10}\right]^2$
4.0	0.294	$y_6 = \frac{(10)(29.82)(540)}{(10.025)(29.82 + 4/13.6)(538.5)}$	$H@_6 = \frac{(.0317)(4.0)}{(29.82)(540)} \left[\frac{(538.5)(10.0)}{10}\right]^2$

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

Quality Assurance Handbook M4-2.3A (front side)

Distribution List

	Copies
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* U. S. GOVERNMENT PRINTING OFFICE: 1990--761-051/20106